LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the eighteenth of the preceding month, for the second issue, the third of the month. Because of the late closing dates for the section no proof can be shown to authors. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

Intrinsic Variability of the So-Called Fundamental Physical Constants

Several years ago I pointed out[1–3] that formulations of natural laws which imply the possibility of *absolute* verification through a finite number of observations are intrinsically inadequate and must in course of time give way to statistically flexible formulations of natural laws. The considerations which led to the conclusion just stated were illustrated by predictions regarding the necessarily to be expected variability of physically significant pure numbers, such as the fine structure constant $\alpha=2\pi e^2/hc$, the ratio of the rest masses of proton and electron $r=m_p/m_e$ and the ratio of the electric radius to the gravitational radius of the electron $R=e^2/\Gamma m_e^2$, (Γ = universal gravitational constant), numbers which previously had been considered as absolute constants. The programmatic value of these considerations is accentuated by recent developments in the physics of elementary particles as well as in cosmology.

It was for instance stated,[1–4] that, if $p=e$, m, μ, etc., is the charge, the rest mass, the magnetic moment and so on of an elementary particle, p would occasionally be found to assume values different from those generally accepted for the known elementary particles. The actual occurrence in cloud chamber photographs was pointed out of particles whose e/m is *different* from that of any conventional elementary particle.[1] It was suggested that easily observable deviations from the conventional values of p might be expected, especially under the following circumstances:

(a) If time intervals are considered which are long enough to change the general physical conditions in the universe, such as for instance the wholesale distribution of matter and radiation, a distribution which by present theories is made responsible for the values of the inertial mass of matter.

(b) If accidental happenings, such as impacts among particles and among particles and photons, possess characteristics which may especially facilitate the realization of intrinsic transformations of the considered elementary units.

Considerations of the type (a) have since been elaborated and in part tested experimentally by the writer,[3, 5] as well as by other authors[6] in an attempt to arrive at a deeper understanding of the redshift of light from distant nebulae and other astronomical phenomena. The possible variability of R, r and α has been shown to open up entirely new outlooks if time intervals of the order of a billion years are considered.

Processes of the type (b) have recently been suggested by many authors[7] in discussions of the penetrating cosmic-ray particles whose existence confirms the prediction that the assumption of the variability of the physical properties p of elementary particles would prove indispensible for a rational understanding of cosmic-ray phenomena, as I stated long before the recent developments.[1–4]

In this connection a trebly reflected cloud chamber track of a charged particle described by G. Herzog and P. Scherrer[8] is of considerable interest. The succession of curvatures on this track would seem to point to a violation of the principle of conservation of energy, and the mentioned authors therefore dismiss it as accidental. The track, however, also admits of an interpretation in terms of changing values of e/m caused by violent collisions.

Gains in energy, as in the track just mentioned, as well as the excessive losses of energy, described for instance by W. Bothe,[9] might often be only apparent, because of a decrease or an increase in the value of e/m of an elementary particle during a collision. This possibility suggests a systematic reexamination of single and multiple reflections of very fast electrons on for instance solid surfaces and in gases. Positive results of such experiments would put on a new basis the interpretation of changes in curvature of the path of particles passing through matter.

Finally it can be shown that the preceding considerations suggest important modifications in the formulation of the uncertainty principle of quantum mechanics, and I therefore intend to present the implications involved in more detail in another place.

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[7] See for instance H. Euler, Physik. Zeits. **38**, 943 (1937); G. E. M. Jauncey, Phys. Rev. **52**, 1256 (1937); S. H. Neddermeyer, Phys. Rev. **53**, 102 (1938).
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[9] W. Bothe, *Kernphysik* (Ed. E. Bretscher), (Verlag J. Springer, Berlin, 1936) p. 76.